REMARKS

Claims 1, 4-5, 7-8, 11-12 and 14 are pending in the Application.

Claims 1, 4-5, 7-8, 11-12 and 14 are rejected under 35 U.S.C. § 103(a).

Applicants have added claims 15-20 and hence claims 1, 4-5, 7-8, 11-12 and 14-20 are pending in the Application.

Applicants respectfully traverse these rejections for at least the reasons stated below, and respectfully request the Examiner to reconsider and withdrawal these rejections.

I. REJECTIONS UNDER 35 U.S.C. § 103(a):

The Examiner has rejected claims 1, 4-5, 8 and 11-12 under 35 U.S.C. § 103(a) as being unpatentable over Hori et al. (U.S. Patent No. 5,320,974) (hereinafter "Hori") in view of Wolf et al. ("Silicon Processing for the VLSI Era, Volume 1 – Process Technology", pp. 321 – 324) (hereinafter "Wolf"). Paper No. 26, page 3. The Examiner has further rejected claims 7 and 14 under 35 U.S.C. § 103(a) as being unpatentable over Hori in view of Wolf and further in view of Thackeray et al. (U.S. Patent No. 6,037,107) (hereinafter "Thackeray"). Applicants respectfully traverse these rejections for at least the reasons provided below and respectfully request the Examiner to reconsider and withdraw these rejections.

A. By combining Hori with Wolf, the principle of operation of Hori would change.

If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. *In re Ratti*, 370 F.2d 810, 123 U.S.P.Q. 349 (C.C.P.A. 1959). Further, if the proposed modification would render the prior art invention being modified unsatisfactorily for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 F.2d 900, 221 U.S.P.Q. 1125 (Fed. Cir. 1984). For the reasons discussed below, Applicants submit that by combining Hori with Wolf,

the principal of operation in Hori would change and subsequently render the operation of Hori to perform its purpose unsatisfactorily.

Hori teaches forming sidewall spacers, spacers 5a and 5b, made of silicon nitride film. Column 6, lines 27 through 29. Hori further teaches that the exposed portions of a silicon oxide film, silicon oxide film 3, on the silicon substrate are removed so as to expose the silicon substrate thereunder. Column 6, lines 29-31. Hori further teaches that arsenic ions are implanted into the substrate using the gate electrode and sidewall spacers, spacers 5a and 5b, as a mask thereby forming an n^+-type source region and an n^+-type drain region. Column 6, lines 31-36. Hori further teaches depositing a titanium film with a thickness of 40 to 60 nanometers on the top surface of the substrate. Column 6, lines 37 – 39. Hori further teaches a heat treatment at a temperature of 600° C to 850° C is conducted to allow the titanium film to react with the silicon substrate thereby forming titanium silicide films 8a, 8b, and 8c with a thickness of 60 to 100 nanometers, respectively. Column 6, lines 39-44. Hori further teaches that since the titanium film does not react with the silicon nitride film, the titanium films on the sidewall spacers, spacers 5a and 5b, remain unreacted. Column 6, lines 44 – 47. Hori further teaches that sidewall spacers, spacers 5a and 5b, are removed by a dry etching using an etching gas. Column 6, lines 50-52. Hori further teaches that boron ions are implanted using the gate electrode and the titanium silicide films 8a and 8b on the source and drain regions as a mask. Column 6, lines 53-56. Hori further teaches that p^+-type semiconductor regions 10a and 10b are formed as punch through stoppers. Column 6, lines 62-64. Hori further teaches that since the ion stopping power of titanium silicide is about 1.5 times higher than that of silicon, the boron ions are not allowed to permeate near pn-junctions between the n^+-type source and drain regions 7a and 7b and the substrate. Column 6, lines 64-68. Hori further teaches that as a result of the above-outlined process, p^+-type semiconductor regions 10a and 10b are formed only in a channel region. Column 6, line 68 – column 7, line 2. Hori further teaches that by not forming the p^+-type semiconductor regions 10a and 10b under the n^+ - type source and drain regions it is possible to obtain the high speed semiconductor transistor device with a small

parasitic junction capacitance and a low impurity concentration in the center of the channel region. Column 7, lines 22-29.

Wolf, on the other hand, teaches that an appropriate mask layer needs to be present on the wafer surface to restrict the ionic species from being implanted into unwanted substrate regions. Page 321. Wolf further teaches that many materials are used for such masking purposes in IC fabrication including photoresist, SiO_2, Si_3N_4, polysilicon, metal films and polyimide. Page 321.

By combining Hori with Wolf, Hori would no longer be able to form the p^+-type semiconductor regions only in a channel region thereby not being able to obtain a high speed semiconductor transistor device with a small parasitic junction capacitance and a low impurity concentration in the center of the channel region. As stated above, Hori teaches using titanium silicide films 8a and 8b on the source and drain regions as a mask. Hori further teaches that since the ion stopping power of titanium silicide is about 1.5 times higher than that of silicon, the boron ions are not allowed to permeate near pn-junctions between the n^+-type source and drain regions 7a and 7b and the substrate. Wolf, on the other hand, teaches using a photoresist as a mask. The Examiner has not provided any evidence that would suggest that a photoresist would have an ion stopping power similar to titanium silicide which is about 1.5 times higher than that of silicon. In fact, a photoresist has a much lower ion stopping power than titanium silicide and even lower than that of silicon. Applicants respectfully refer the Examiner to the periodic table of elements which indicates that silicon has an atomic number of 14, carbon has an atomic number of 6, and titanium has an atomic number of 81. The greater the number of the atomic number, i.e., the greater number of protons in the nucleus and the number of electrons orbiting the nucleus, the greater the ion stopping power. Since the atomic number of carbon, which a photoresist is mainly comprised of, is lower than the atomic number of silicon, one may conclude that the ion stopping power of a photoresist is less than that of silicon. Hence, by replacing titanium silicide with a photoresist, the ion stopping power will be less than that of silicon and hence not be able to prevent boron ions

from permeating near pn–junctions between the n^+-type source and drain regions and the substrate. Hence, by combining Hori with Wolf, Hori would no longer be able to form p^+-type semiconductor regions only in a channel region thereby not being able to obtain a high speed semiconductor transistor device with a small parasitic junction capacitance and a low impurity concentration in the center of the channel region. Thus, by combining Hori with Wolf, the principle of operation in Hori would change, and subsequently render the operation of Hori to perform its purpose unsatisfactorily. Therefore, the Examiner has not presented a *prima facie* case of obviousness for rejecting claims 1, 4-5, 7-8, 11-12 and 14. *In re Ratti*, 270 F.2d 810, 123 U.S.P.Q. 349 (C.C.P.A. 1959); *In re Gordon*, 733 F.2d 900, 221 U.S.P.Q. 1125 (Fed. Cir. 1984).

B. The Examiner is not providing any objective evidence for combining Hori with Thackeray.

A *prima facie* case of obviousness requires the Examiner to establish, *inter alia*, that the prior art references teach or suggest, either alone or in combination, all of the limitations of the claimed invention, and the Examiner must provide a motivation or suggestion to combine or modify the prior art reference to make the claimed inventions. M.P.E.P. §2142. The showings must be clear and particular. *In re Lee*, 277 F.3d 1338, 1343, 61 U.S.P.Q.2d 1430, 1433-34 (Fed. Cir. 2002); *In re Kotzab*, 217 F.3d 1365, 1370, 55 U.S.P.Q.2d 1313, 1317 (Fed. Cir. 2000); *In re Dembiczak*, 50 U.S.P.Q.2d 1614, 1617 (Fed. Cir. 1999). Broad conclusory statements regarding the teaching of multiple references, standing alone, are not evidence. *Id.*

In order to reject under 35 U.S.C. § 103, therefore, the Examiner must provide a proper motivation for combining or modifying the references. *In re Rouffet*, 47 U.S.P.Q.2d 1453, 1457-1458 (Fed. Cir. 1998); M.P.E.P. § 2142. The Examiner's motivation for modifying Hori with Wolf and Thackeray to include a photoresist layer that comprises a deep ultraviolet layer, as recited in claim 7 and 14, is to "provide[s] patterns of reduced feature size." Paper No. 26, page 5. This motivation is insufficient to support a *prima facie* case of obviousness since it is merely the Examiner's own subjective opinion.

Applicants respectfully assert that the Examiner's motivation is not a proper motivation for modifying Hori to provide a photoresist layer to the semiconductor device that covers a substantial amount of an active area where the photoresist layer comprises a deep ultra violet layer. There is no suggestion in Hori to provide patterns of reduced featured size. The Examiner must provide objective evidence and not rely on his own subjective opinion in support of modifying Hori to provide patterns of reduced featured size. *In re Lee*, 61 U.S.P.Q.2d 1430, 1434 (Fed. Cir. 2002). Consequently, the Examiner's motivation is insufficient to support a *prima facie* case of obviousness since it is merely the Examiner's subjective opinion. *Id.*

Further, Hori teaches removing insulating films that were formed on the sidewalls of a gate electrode for a self-alignment to selectively implant impurities only into end portions of a source region and a drain region. Abstract.

Thackeray, on the other hand, teaches a photoresist composition comprising a resin binder having acid labile blocking groups requiring an activation energy in excess of 20 Kcal/mol. for deblocking, a photoacid generator capable of generating a halogenated sulfonic acid upon photolysis and optionally a base additive. Abstract.

The Examiner must submit objective evidence and not rely on his own subjective opinion in support of combining a reference (Hori) that teaches removing insulating films formed on the sidewalls of a gate electrode for a self-alignment to selectively implant impurities only into end portions of a source and a drain region with a reference (Thackeray) that teaches a photoresist composition that includes a resin binder having acid labile blocking groups requiring an activation energy in excess of 20 Kcal/mol. for deblocking, a photoacid generator capable of generating a halogenated sulfonic acid upon photolysis and optionally, a base additive. *In re Lee*, 61 U.S.P.Q.2d 1430, 1434 (Fed. Cir. 2002).

Further, the Examiner must submit objective evidence and not rely on his own subjective opinion in support of modifying Hori to provide a thin photoresist layer that comprises a deep ultra violet layer. *Id.* There is no suggestion in Hori to provide a thin photoresist layer to cover the source and drain regions where the photoresist

layer comprises a deep ultra violet layer. Therefore, the Examiner has not presented a *prima facie* showing of obviousness for rejecting claims 7 and 14. M.P.E.P. § 2143.

C. **By combining Hori with Thackeray, the principle of operation of Hori would change.**

If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. *In re Ratti*, 370 F.2d 810, 123 U.S.P.Q. 349 (C.C.P.A. 1959). Further, if the proposed modification would render the prior art invention being modified unsatisfactorily for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 F.2d 900, 221 U.S.P.Q. 1125 (Fed. Cir. 1984). For the reasons discussed below, Applicants submit that by combining Hori with Wolf, the principal of operation in Hori would change and subsequently render the operation of Hori to perform its purpose unsatisfactorily.

As stated above, Hori teaches forming sidewall spacers, spacers 5a and 5b, made of silicon nitride film. Column 6, lines 27 through 29. Hori further teaches that the exposed portions of a silicon oxide film, silicon oxide film 3, on the silicon substrate are removed so as to expose the silicon substrate thereunder. Column 6, lines 29-31. Hori further teaches that arsenic ions are implanted into the substrate using the gate electrode and sidewall spacers, spacers 5a and 5b, as a mask thereby forming an n^+-type source region and an n^+-type drain region. Column 6, lines 31-36. Hori further teaches depositing a titanium film with a thickness of 40 to 60 nanometers on the top surface of the substrate. Column 6, lines 37 – 39. Hori further teaches a heat treatment at a temperature of 600° C to 850° C is conducted to allow the titanium film to react with the silicon substrate thereby forming titanium silicide films 8a, 8b, and 8c with a thickness of 60 to 100 nanometers, respectively. Column 6, lines 39-44. Hori further teaches that since the titanium film does not react with the silicon nitride film, the titanium films on the sidewall spacers, spacers 5a and 5b, remain unreacted. Column 6, lines 44 – 47. Hori further teaches that sidewall spacers, spacers 5a and 5b, are removed by a dry etching using an etching

gas. Column 6, lines 50-52. Hori further teaches that boron ions are implanted using the gate electrode and the titanium silicide films 8a and 8b on the source and drain regions as a mask. Column 6, lines 53-56. Hori further teaches that p^+-type semiconductor regions 10a and 10b are formed as punch through stoppers. Column 6, lines 62-64. Hori further teaches that since the ion stopping power of titanium silicide is about 1.5 times higher than that of silicon, the boron ions are not allowed to permeate near pn-junctions between the n^+-type source and drain regions 7a and 7b and the substrate. Column 6, lines 64-68. Hori further teaches that as a result of the above-outlined process, p^+-type semiconductor regions 10a and 10b are formed only in a channel region. Column 6, line 68 – column 7, line 2. Hori further teaches that by not forming the p^+-type semiconductor regions 10a and 10b under the n^+ - type source and drain regions it is possible to obtain the high speed semiconductor transistor device with a small parasitic junction capacitance and a low impurity concentration in the center of the channel region. Column 7, lines 22-29.

Thackeray, on the other hand, teaches a photoresist composition comprising a resin binder having acid labile blocking groups requiring an activation energy in excess of 20 Kcal/mol. for deblocking, a photoacid generator capable of generating a halogenated sulfonic acid upon photolysis and optionally a base additive. Abstract.

By combining Hori with Thackeray, Hori would no longer be able to form the p^+-type semiconductor regions only in a channel region thereby not being able to obtain a high speed semiconductor transistor device with a small parasitic junction capacitance and a low impurity concentration in the center of the channel region. As stated above, Hori teaches using titanium silicide films 8a and 8b on the source and drain regions as a mask. Hori further teaches that since the ion stopping power of titanium silicide is about 1.5 times higher than that of silicon, the boron ions are not allowed to permeate near pn-junctions between the n^+-type source and drain regions 7a and 7b and the substrate. Thackeray, on the other hand, teaches a photoresist composition. The Examiner has not provided any evidence that would suggest that a photoresist would have an ion stopping power similar to titanium silicide which is

about 1.5 times higher than that of silicon. In fact, a photoresist has a much lower ion stopping power than titanium silicide and even lower than that of silicon. Applicants respectfully refer the Examiner to the periodic table of elements which indicates that silicon has an atomic number of 14, carbon has an atomic number of 6, and titanium has an atomic number of 81. The greater the number of the atomic number, i.e., the greater number of protons in the nucleus and the number of electrons orbiting the nucleus, the greater the ion stopping power. Since the atomic number of carbon, which a photoresist is mainly comprised of, is lower than the atomic number of silicon, one may conclude that the ion stopping power of a photoresist is less than that of silicon. Hence, by replacing titanium silicide with a photoresist, the ion stopping power will be less than that of silicon and hence not be able to prevent boron ions from permeating near pn–junctions between the n^+-type source and drain regions and the substrate. Hence, by combining Hori with Thackeray, Hori would no longer be able to form p^+-type semiconductor regions only in a channel region thereby not being able to obtain a high speed semiconductor transistor device with a small parasitic junction capacitance and a low impurity concentration in the center of the channel region. Thus, by combining Hori with Thackeray, the principle of operation in Hori would change, and subsequently render the operation of Hori to perform its purpose unsatisfactorily. Therefore, the Examiner has not presented a *prima facie* case of obviousness for rejecting claims 1, 4-5, 7-8, 11-12 and 14. *In re Ratti*, 270 F.2d 810, 123 U.S.P.Q. 349 (C.C.P.A. 1959); *In re Gordon*, 733 F.2d 900, 221 U.S.P.Q. 1125 (Fed. Cir. 1984).

D. Hori, Wolf and Thackeray, taken singly or in combination, do not teach or suggest the following claim limitations.

Applicants further assert that Hori, Wolf and Thackeray, taken singly or in combination, do not teach or suggest "providing a thin photoresist layer" as recited in claim 1 and similarly in claim 8. The Examiner cites page 321 of Wolf as teaching the above-cited claim limitation. Paper No. 26, page 3. Applicants respectfully traverse and assert that Wolf instead teaches using a photoresist as a mask layer to restrict the ionic species from being implanted into unwanted substrate regions.

However, the language in the cited passage does not specifically state using a thin photoresist layer. Further, the Examiner has not provided any objective evidence for modifying Hori to provide a thin photoresist layer. Therefore, the Examiner has not presented a *prima facie* case of obviousness, since the Examiner is relying upon an incorrect, factual predicate in support of the rejection. *In re Rouffet,* 47 U.S.P.Q.2d 1453, 1455 (Fed. Cir. 1998).

Applicants further assert that Hori, Wolf and Thackeray, taken singly or in combination, do not teach or suggest "providing the halo implant to the semiconductor device, wherein the thin photoresist layer is used as a mask" as recited in claim 1 and similarly in claim 8. The Examiner cites Wolf as teaching the above-cited claim limitation. Paper No. 26, page 3. Applicants respectfully traverse. As stated above, Wolf instead teaches using a photoresist as a mask layer to restrict the ionic species from being implanted into unwanted substrate regions. However, the language in the cited passage does not teach using a thin photoresist layer as a mask. Further, the Examiner has not submitted any objective evidence for modifying Hori to use a thin photoresist layer as a mask. *In re Lee*, 61 U.S.P.Q.2d 1430, 1434 (Fed. Cir. 2002). Therefore, the Examiner has not presented a *prima facie* case of obviousness, since the Examiner is relying upon an incorrect, factual predicate in support of the rejection. *In re Rouffet*, 47 U.S.P.Q.2d 1453, 1458 (Fed. Cir. 1998).

Applicants respectfully assert that Hori, Wolf and Thackeray, taken singly or in combination, do not teach or suggest "providing a first photo resist layer of a thickness .55 micrometers or greater over an oxide trench of said semiconductor device" as recited in claim 15. Accordingly, the Examiner has not presented a *prima facie* case of obviousness for rejecting claim 15. M.P.E.P. § 2143.

Applicants further assert that Hori, Wolf and Thackeray, taken singly or in combination, do not teach or suggest "removing said first photoresist layer" as recited in claim 15. Accordingly, the Examiner has not presented a *prima facie* case of obviousness for rejecting claim 15. M.P.E.P. § 2143.

Applicants further assert that Hori, Wolf, and Thackeray, taken singly or in combination, do not teach or suggest "providing a second photoresist layer of a thickness between .1 μm to .2 μm over said oxide trench and a substantial portion of a source and a drain region" as recited in claim 15 and similarly in claim 18. Accordingly, the Examiner has not presented a *prima facie* case of obviousness for rejecting claims 15 and 18. M.P.E.P. § 2143.

Applicants further assert that Hori, Wolf and Thackeray, taken singly or in combination, do not teach or suggest "implanting a halo implant using said second photoresist layer as a mask" as recited in claim 15 and similarly in claim 18. Accordingly, the Examiner has not presented a *prima facie* case of obviousness for rejecting claims 15 and 18. M.P.E.P. § 2143.

Claims 4, 5, 7, 11, 12, 14, 16-17 and 19-20 recite combinations of futures including the above combinations, and thus are patentable for at least the above reasons as well. Claims 4, 5, 7, 11, 12, 14, 16-17 and 19-20 recite additional features, which, in combination with the features of the claims upon which they depend, are patentable over Hori in view of Wolf and in further view of Thackeray.

As a result of the foregoing, Applicants respectfully assert that there are numerous claim limitations not taught or suggested in the cited prior art, and thus the Examiner has not presented a *prima facie* case of obviousness for rejecting claims 1, 4-5, 7-8, 11-12 and 14-20 as being unpatentable over Hori in view of Wolf and in further view of Thackeray.

II. CONCLUSION:

As a result of the foregoing, it is asserted by Applicants that claims 1, 4-5, 7-8, 11-12 and 14-20 in the application are in condition for allowance, and Applicants respectfully request an allowance of such claims. Applicants respectfully request that the Examiner call Applicants' attorney at the below listed number if the Examiner believes that such a discussion would be helpful in resolving any remaining issues.

Respectfully submitted,

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